The present invention relates to staple driving tools of the type generally used to apply and set staples in containers for closing thereof and/or to secure bands around containers for securing the closures thereof, as well as for other purposes.

The general object of the invention is to provide a new and improved stapling tool designed for use as aforementioned and, in particular it is an object of the invention to provide a new and improved means designed to use pneumatic pressure for driving staples.

Another object of the invention resides in the provision, in combination, of a piston with a piston latching and releasing means so constructed and arranged as to facilitate rapidity of staple driving blade operation under conditions of minimum wear and vibratory shock.

Other objects of the invention grouped together with features and advantages thereof reside in the provision of a full floating piston and driving blade for driving staples; a novel means to latch or retain the piston and driving blade in a fixed position pending the next operational move thereof; a novel means utilizing pressure air for the release of the latching means holding the piston-driver blade for an operational move thereof; ease, facility and efficiency in use, together with such other objects, features and advantages as may be noted from a study of the drawing, the detailed description thereof and the subjoined claims.

In the drawing:

Figure 1 is a side-elevation view of the stapler tool of this invention and,

Figure 2 is a mid-longitudinal sectional view thereof,

Figure 3 is an enlarged mid-sectional view of a portion of the stapler showing the piston with its latching and releasing means.

Figures 4, 5, 6 and 7 respectively, are transverse sectional views taken along lines 4—4, 5—5 and 6—6 on Figure 3 and, 7—7 on Figure 2, all designed to show structure and structural arrangement in the tool which is not otherwise clearly discernable.

Figure 8 is a mid-longitudinal section showing a fragment of a driver blade and a driver blade piston of the type shown in Figure 3 but showing a modified form of latching and releasing means therefor, see line 8—8, Figure 9.

Figures 9 and 10 are transverse sectional views as seen along lines 9—9 and lines 10—10 on Figure 8 to show construction related to the organization shown in Figure 8.

The pneumatic stapler of this invention as shown in the drawing is embodied within a body structure 1 having a pistol type hand grip 2 for manual control thereof.

Within the body there is a cylindrical bore 3 for a driver blade piston and an aligned counter-bore 3a of somewhat greater diameter for a piston latching mechanism 4.

The bores 3 and 3a are closed by end closure plates 5 and 6 respectively.

A nose member 7 extends forwardly of and from the closure plate 5 and is provided with a slot 8 extending therethrough which is medially and longitudinally aligned with the bore 3. A staple magazine 9 of conventional form is dependently although detachably supported by the nose member in such manner that staples 11 are continuously fed into the throat or slot 8 wherefrom they are driven into the work (not shown) by a driver blade 11a operating within the slot 8 as will hereinafter be described.

A piston 12 formed with a skirt 13 having an inwardly directed annular flange 14 is attached to the driving blade for functional use operation thereof and, is slidable movable through a limited operational range within the bore 3. A spring 15 extending through the cylinder 3 under a degree of compression in abutment with the end closure plate 5 and the related side of the piston and, a pin 16 secured in the end closure plate 6 and associated with the latching mechanism 4 are adapted to normally hold the piston and driver blade at the place ofbegins[

Within the bore 3a and centered upon the pin 16 we place a latch finger hanger yoke 17 having bifurcated ends within which we pivotally position the latch fingers 18 which are arranged for limited vertical oscillation and to this end the bottom of the slot within which the fingers are placed is angularly inclined for accommodation of this movement.

The yoke 17 is counter-bored at 19 in axial alignment with the opening therethrough for the pin 16 and this bore provides a seat for one end of a spring 20 which rests therein in abutment with the body of the yoke.

A latch finger cam roller yoke 21 is slidable positioned upon the pin 16 in abutment with a boss 16a formed thereon and this yoke is also formed with a counterbore centered upon the opening therein for the pin 16. Yoke 21 is also bifurcated or slotted to receive the latching fingers extending therethrough as shown in Figures 3 and 5 and, as mentioned in reference to yoke 17 the bottom of these slots are also angularly inclined for accommodation of limited vertical movement of the latches below a horizontal plane extending therethrough, see the dotted line position of these latches in Figure 3.

As previously mentioned, the latches 18 are pivotally mounted in the yoke 17 and extend through the slotted end portions of the yoke 21 to engage the annular rim of the piston by means of a lip 18a formed on each thereof while immediately of the ends of the fingers we form an inclined roller surface or cam-way 18b which in a relative movement of or between the cam-way and a roller 22 positioned in each of the slotted ends of the yoke 21 are adapted to depress the free end of the fingers and hence effect disengagement with the piston. Pockets 23 are bored into the bottom of each of the slots in the yoke 21 to form a seat for a spring 24 the opposite end of each of which presses outwardly upon the under side of an associated latching finger and serves the function of holding the latching fingers in engagement with the annular flange 14 upon the piston.

An air hose 25 is adapted to conduct pressure air from a source not shown to the stapler with which it is connected by a fitting 26 and from which fitting pressure air flows through a passageway 27 in the handle 2 to a valve chamber 28 therein. Finger pressure upon the valve actuating trigger 29 actuates the valve 30 to permit pressure air to flow into chamber 28a and thence into the bore or cylinder 3a.

It is to be noted at this time that the piston is centered between the spring 15 and the pin 16; and, that the latching fingers under pressure of springs 24 are in engagement with the annular rim or flange 14 of the piston; and, that the yokes 17 and 21 are held in the position shown in Figures 2 and 3, yoke 21 being in spring-pressure surized abutment with the boss 16a and yoke 17 being
spring pressed outwardly against a spacer 16b upon the pin 16. It is to be noted that the position of each of these yokes is relatively fixed, but not entirely so, because the yoke 17 being connected to the piston by means of the latch spring 31, it may be actuated against the spring 20, while on the other hand the more firmly yoke 17 presses against spring 20 the more firmly yoke 21 is held immobile against the boss 16a on the pin 16.

With the preceding resumed of the respective positions of and conditions applicable to the working parts of the stop in mind as of the beginning of a power stroke, functional usage thereon will now be set forth.

Finger pressure upon the trigger 29 opens valve 30 and admits pressure air into the chamber 3a pressing against the piston 12 and causing the same to move slightly outwardly from its place of beginning and carrying the latch springs and the yoke 17 therewith compresses the spring 20 so that the yoke 21 is held against the boss 16a in a degree of firmness proportional to the pressure bearing against it, however, as pressure builds up in the cylinder 3a the piston and latchings engineers slowly (as at the beginning of a power stroke) advance in the direction of the base. As the fingers are pressed inwardly to the dotted line position thereof because of pressure exerted upon them by the relative motion between the rollers 22 and the cam-ways 18b.

It will thus be seen that the construction, arrangement and inter-dependence of the piston, latchings engineers, springs and the yokes all function to effect an initial retarding of piston movement and an accumulation of pressure air of optimum value and that when such optimum pressure has been attained the forward creeping of the piston has caused the sloping cam surfaces 18b to engage the rollers 22 and thus move the latch ends 18b inward sufficient amount as to release the piston under an accumulated air pressure which drives the piston the length of its stroke, carrying the driver blade 11a therewith and forcing a staple 11 from a clip thereof in the magazine 9 into the work which is not shown in the drawing.

The power stroke is arrested by the work done in driving a staple and by compressing the spring 15 which returns the piston to its place of beginning for a next stroke. Spent pressure-air is vented through ports 31 in the trigger-pressed, spring resisted sleeve valve 31a. Further use of the stapler is repetitious of the aforesaid action.

In Figures 8, 9 and 10 we show a modified form of means to hold and subsequently release the piston 12. Reference to the drawing will show that a centering pin 40 is threaded directly to the pin 6 and that there is an inclined cam-like flange 41 on the pin 40 adjacent the cap 6. A latch carrier yoke 42 having bifurcated ends 43 is slidedly fitted on the pin forwardly of the cam 41. Latches 44 extending through the bifurcated slots 43a are fulcruled on pins 45 traversing the slots 43a for limited oscillatory movement. The forward end of the latches have lips to engage the flange 41 of the piston 12 in the manner described in connection with structure illustrated in Figure 3, however, the heel of these latches are formed with dogs 46 having inclined faces mated to align with the cam-like surfaces of the flange 41 to accommodate a sliding movement therebetween. A spring 47 upon the pin 40 is socketed in a recess formed in and centered around the bore extending through the yoke 42 and is held under an initial tension by means of a collar 49 on the pin. From a point adjacent the collar 49 the pin 40 extends forwardly a sufficient length to form an abutment or stop for the piston when at rest in the manner described in connection with the structure shown in Figure 3.

In use, operation of this form of piston latch engaging device may be described as follows: As pressure-air accumulates in the cylinder 3a the piston and the latches 44 initially carry the latch carrier yoke 42 a limited distance along the pin 40 against resistance of the spring 47. Since the pin 40, similar to pin 12 is stationary and the latches are movable, the dogs 46 are forced to slide upwardly along the faces of the cam 41 which movement is resisted by the dog 46 contacting the flange 41 thereby forming a rear stop limit for said piston and a support for said retarding mechanism, the latter including spring pressed latches urged to position to releasably engage said piston, and means included in said retarding mechanism to cam the latches as the piston moves, whereby to disengage said latches from the piston.
subsequently to an initial stage operative movement there- 5
of, means to return said piston to its place of beginning a power stroke, and an air valve to admit pressure air for actuation of said piston.

6. In a device of the character described, a housing having a cylindrical bore, a piston slideable in said bore and actuated by air pressure in response to the opening and closing of a pressure air valve, retarding mechanism for said piston comprising latches normally in engagement with said piston, means in said retarding mechanism adapted upon an initial stage operative movement of said piston including said latches to effect an actuation of said mechanism adapted to disjoin said piston and latches whereby said piston is released under a condition of an optimum air pressure value for a power stroke, said retarding mechanism including a pin within said body and aligned with the bore in said housing, said pin being fixedly secured to a closure cap at its one end and having its other end in abutment with said piston when in static position, a cam on said pin adjacent said closure cap, a latch carrier yoke slideable on said pin and having bifurcated ends within which said latches are fulcrumed for limited oscillatory movement, a collar on said pin and a spring on said pin intermediate said collar and said carrier yoke adapted to normally thrust said carrier yoke into abutting contact with said cam, dogs on said latches adapted and arranged to be in relative motion with respect to said cam upon a work movement of said piston and the latches engaged therewith whereby the latching ends of the latches are disengaged from and release said piston for a work stroke thereof after an initial movement of the piston, and means to return said piston to a place of beginning subsequent to a power stroke thereof.

7. In a device of the character described in which a piston is driven by air pressure, retarding mechanism for releasing the piston as the air pressure reaches a chosen amount, said mechanism including two relatively movable members, one of said members moving with the piston until the piston is released for its power stroke, and means for returning said movable member to initial position during said power stroke; said other member is located between the piston and the member moving therewith and carries a plurality of rollers and the member movable with the piston has pivoted thereto a plurality of latch fingers, said fingers having cammed surfaces to engage said rollers as said members approach each other.

8. The device of claim 7 in which the piston has a latch engaging portion and the ends of the latch engaging portion, the camming action of the rollers and the cam surfaces moving the fingers about their pivots so that the latching ends move toward each other, and spring means urging the two members apart and urging the fingers into latching position.

9. A releasing mechanism, including a housing having a cylindrical bore therein, a piston fitting said bore, means for admitting air under pressure to said bore, a pin secured to the housing coaxially with said bore, a member axially slideable on said pin, a latch finger pivoted to said member and having a forward latch engaging portion carried by said pin, a cam actuator fixed with respect to the pin and lying in the path of movement of said cam surface on the latch finger as the piston and the slideable member move forward, a latch engaging portion carried by the piston, and spring means yieldingly holding the latching end of said finger in contact with the latch engaging portion of the piston, whereby as the air pressure admitted to the bore increases, the piston and the axially slideable member will move forwardly together without releasing the piston until the air pressure has built up to a sufficient amount as to bring the cam surface in contact with the cam actuator, further forward movement of the piston under urge of the increasing air pressure releasing the engagement between the piston and the latch finger because of the camming action, and allowing the piston to move forward rapidly under the full power of the built up air pressure.

10. The releasing mechanism of claim 9 in which the latch engaging portion of the piston includes an inwardly directed annular flange, the cam actuator is an annular cam on the pin, and additional means separately return the piston and the sliding member to their initial positions.

11. The releasing mechanism of claim 10, in which there is a plurality of latch fingers which are independently spring pressed into latching position, the cam is conical, and the pin forms a rear stop for the piston.

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